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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/549,683	09/19/2005	Jun Suda	HIRA.0204	1086

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1792	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/549,683	SUDA ET AL.	
	Examiner	Art Unit	
	MATTHEW J. SONG	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *23 May 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *22-39 and 48-58* is/are pending in the application.

4a) Of the above claim(s) *27-39,48,49,53 and 54* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *22-26,50-52 and 55-58* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/23/2008*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 25 and 56 are objected to because of the following informalities: Claims 25 and 56 are identical; therefore the Examiner suggests cancelling one of the claims. Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 22-23, 25-26, 50-51 and 55-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Powell et al (US 6,165,874) in view of Semond et al (WO 01/95380 A1), where US 2003/0136333 A1 is used as an accurate translations, and in view of Li et al ("Field-

ion scanning tunneling microscopy study of the atomic structure of 6H-SiC (001) surfaces cleaned by in situ Si molecular beam etching").

Powell et al teaches a method of growing a GaN film on a 6H-SiC substrate having steps **41** and terraces (Fig 5 and col 17, ln 50-67), where the terraces are the flat area between the steps. Powell et al also teaches forming GaN on the SiC substrate (col 18, ln 1-35 and col 22, ln 15-60).

Powell et al does not teach removing an oxide film, performing at least one cycle of Si or Ga irradiation, heating and then growing a Group III nitride.

In a method of growing GaN (a group III nitride), note entire reference, Semond et al teaches preforming deoxidation by annealing to remove native oxide ('333 [0089]), this clearly suggests applicant's oxide removal step. Semond et al also teaches using a SiC substrate. ('333 [0039]) and using Molecular beam epitaxy to form GaN ('333 [0093]-[0098]), this clearly suggests irradiation with Ga because MBE comprises irradiation with Ga beams. Semond et al teaches growing GaN at 780°C, then heating to 900°C and then GaN growth at 780°C ('333 [0094]-[0097] and Fig 1).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Powell et al by using the method of GaN growth on a SiC substrate, taught by Semond et al, to produce a crack free GaN suitable for electronic devices ('333 [0002], [0040] and Abstract).

The combination of Powell et al and Semond et al does not teach irradiating a Si or Ga atomic beam on the surface and then heating the irradiated surface thereby separating the Ga or Si from the irradiated surface and removing oxygen on the surface.

In a method of cleaning a SiC substrate, note entire reference, Li et al teaches removal of SiO_2 by Si beam etching where a 5 minute exposure to a Si beam at 900-950°C was surface to remove SiO_2 films to obtain a clean SiC surface exhibiting large terraces (pg 2524). This clearly suggests irradiating the surface with a Si beam and separating the Si from the irradiated surface and removing oxygen on the surface.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell et al and Semond et al by using the Si beam irradiation taught by Li et al, to further ensure a clean SiC surface free of oxides.

Li et al teaches heating to 900-950°C and irradiating with a Si beam. Li et al does not explicitly teach that the substrate is irradiated and then heated. In general, the splitting of one step into two, where the processes are substantially identical or equivalent in terms of function, manner and result, was held to be not patentably distinguish the processes. *Ex parte Rubin* 128 USPQ 159 (PO BdPatApp 1959). Therefore, irradiating and then heating would have been obvious to one of ordinary skill in the art because the processes are identical in terms of function (remove oxygen), manner (heating and Si beam irradiation) and result (clean substrate).

Referring to claims 23, the combination of Powell et al, Semond et al and Li et al teaches ultrahigh vacuum. ('333 [0106]).

Referring to claim 25, the combination of Powell et al, Semond et al and Li et al teaches Ga MBE at 780°C heating to 900°C and then GaN deposition at 780°C ('333 [Fig 1]).

Referring to claims 26, and 56-58, the combination of Powell et al and Semond et al teaches a SiC substrate and an offset of 0°.

Referring to claim 50, the combination of Powell et al, Semond et al and Li et al teaches froming a step terrace structure, annealing to remove oxide, performing step flow growth to produce a flat surface ('874 col 14, ln 15-45 and col 17, ln 50-67); and performing a GaN layer growth followed by a second GaN layer growth, this clearly suggests feeding nitrogen after the group III element has been fed.

Referring to claim 51, the combination of Powell et al, Semond et al and Li et al teaches feeding Ga, this clearly suggests a surface controlling element. The combination of Powell et al, Semond et al and Li et al also teaches a mixed layer of AlGaN. ('333 pg 6). The combination of Powell et al, Semond et al and Li et al also teaches feeding Ga to deposit a layer of gallium nitride and growth of an intermediate layer and repeating the growth of the intermediate layer ('333 [0047]-[0056]), this clearly suggests layer by layer growth by feeding Ga.

Referring to claim 55, the combination of Powell et al, Semond et al and Li et al teaches an MBE process of supplying Ga to form a GaN layer, this clearly suggests an atomic beam.

4. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell et al (US 6,165,874) in view of Semond et al (WO 01/95380 A1), where US 2003/0136333 A1 is used as an accurate translations, and Li et al ("Field-ion scanning tunneling microscopy study of the atomic structure of 6H-SiC (001) surfaces cleaned by in situ Si molecular beam etching"), as applied to claims 22-23, 25-26, 50-51 and 55-58, and further in view of Forbes et al (US 2004/0164341 A1).

The combination of Powell et al, Semond et al and Li et al teach all of the limitations of claim 24, as discussed previously, except Ga irradiation performed under a high vacuum of 10^{-6} Pa or less.

In a method of MBE of GaN, note entire reference, Forbes et al teaches GaN MBE epitaxy is performed under ultrahigh vacuum, which is typically 10^{-10} Torr ($1x10^{-7}$ Pa).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell et al, Semond et al and Li et al by using the pressure taught by Forbes et al., because the pressure is conventionally known to be used for MBE processes.

5. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Powell et al (US 6,165,874) in view of Semond et al (WO 01/95380 A1), where US 2003/0136333 A1 is used as an accurate translations, Li et al ("Field-ion scanning tunneling microscopy study of the atomic structure of 6H-SiC (001) surfaces cleaned by in situ Si molecular beam etching") and in view of Forbes et al (US 2004/0164341 A1), as applied to claims 22-26, 50-51 and 55-58 above, and further in view of Kitabatake (US 2001/0015170 A1).

The combination of Powell et al, Semond et al, Li et al and Forbes et al teach all of the limitations of claim 52, as discussed previously, except the oxide film is removed using a solution containing fluorine.

In a method of preparing a SiC substrate having steps and terraces, note entire reference, Kitabatake teaches cleaning a SiC substrate by removing a silicon dioxide layer using a HF

group acidic solution [0042]. Kitabatake also teaches the cleaning is effective on a silicon carbide surface having steps and terraces. [0053].

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell et al, Semond et al, Li et al and Forbes et al by cleaning the SiC substrate using an HF solution, as taught by Kitabatake to clean the oxide from the surface because oxide can be detrimental to subsequent film growth.

The combination of Powell et al, Semond et al, Forbes et al, Li et al and Kitabatake does not explicitly teach the clean is performed in an oxygen reduced partial pressure, however it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Powell et al, Semond et al, Forbes et al, Li et al and Kitabatake by cleaning in a oxygen reduce partial pressure because the clean is designed to remove oxide and performing in an oxygen reduce partial pressure would reduce the amount of oxide which would form before, during and after the oxide removal step.

Response to Arguments

6. Applicant's arguments with respect to claims 22-26, 50-52 and 55-58 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. SONG whose telephone number is (571)272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Kornakov can be reached on 571-272-1303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1792

MJS
September 14, 2008

/Robert M Kunemund/
Primary Examiner, Art Unit 1792